NORTHERN SPOTTED OWLS

IN

MARIN COUNTY, CALIFORNIA

2005 Annual Report

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Executive Summary

This report details the results of the ninth year of the Northern Spotted Owl (*Strix occidentalis caurina*) Monitoring Program in Marin County, California. The goal of the monitoring study is to estimate trends in Spotted Owl occupancy rates and productivity on federal, state, county, and water district lands within Marin County. The intended audience of this report includes partners in our joint monitoring program as well as appropriate agencies at the county, state, and federal levels. The report provides an overview of the Marin County Northern Spotted Owl Monitoring Program and summarizes the results of the data collected during the 2005 field season. The report does not include comprehensive descriptions of methodologies or demographic data analysis.

During the 2005 breeding season, Marin County's survey teams made 289 visits to a total of 46 Spotted Owl territories designated as long term monitoring sites. Of the 46 long-term monitoring sites, a subset of 30 sites was randomly selected to determine reproductive status. At the remaining 16 of the 46 long-term monitoring sites, researchers confirmed Spotted Owl occupancy status, at a minimum, including age and band identification of any owls that were observed. An additional 15 sites were monitored based on resource management needs of the land management agencies involved in the project. For this report, only information pertaining to the 46 long-term monitoring sites was included, with the exception of the analyses of nesting habitat, nest structures, and age class of paired owls.

The 2005 breeding season was an average reproductive year for Spotted Owls locally. Pairs of Spotted Owls occupied 83% or 38 of the 46 long-term monitoring sites. At the 30 sites monitored to reproductive status in 2005, a total of 25 sites had pair occupancy. Of the 26 females with known reproductive status, 18 females (69%) attempted nesting. Thirteen of the 18 females successfully nested yielding a confirmed total of 21 young. Twenty percent of nesting attempts in 2005 resulted in nest failure, as defined in the Marin Modified Protocol. A total of four non-nesting females were confirmed at the 30 sites monitored to reproductive status. Fecundity for 2005 in Marin County was 0.46 (s.e. ±0.096) which reflects the average fecundity of 0.46 (s.e. ±0.078) for the years 1998-2005.

A total of 26 nests were located in 2005. Twenty-two nests were new and the four nest structures (three platforms and one cavity) were reused. Of the 195 unique nests documented from 1997 to 2005, 19 (9%) were cavities and 176 (91%) were a type of platform nest. This ratio is the opposite of owl nests in older forests where 80-90% of the nests are in cavities, but closely resembles the ratio in other parts of the range where forests are younger.

In 2004, the banding portion of the study was terminated due to logistical constraints and limited returns from previous efforts. Of the 110 Northern Spotted Owls banded before 2004, 31 (14 females and 17 males) were resighted in 2005 including three that were resighted in new locations. Since 2000, a total of 11 owls (8 juveniles and 3 adults) whose identity can be positively determined have been resighted at new territories. The average distance moved was 4.4 km (n=3) for adults and 7.4 km (n=8) for juveniles.

This Spotted Owl population, at the southern limit of the sub-species' range faces unique threats due to the close proximity of a growing human population. Threats include disturbance by park visitors and birding enthusiasts, development along wildland/urban interfaces, impacts of Sudden Oak Death, the continued Barred Owl (*Strix Varia*) detections in the county, and the spread of West Nile Virus throughout in Marin County. We continue to use our modified protocol that minimizes the use of "mousing," while allowing determination of indicators of population health.

Introduction

The U.S. Fish and Wildlife Service (USFWS) listed the Northern Spotted Owl (*Strix occidentalis caurina*) as a threatened species on June 22, 1990. Northern Spotted Owls are distributed in forested regions from southern British Columbia through Washington, Oregon, and northwestern California. They reach the southern limit of their range in coastal California north of San Francisco Bay, where they occur in Golden Gate National Recreation Area (GOGA), Muir Woods National Monument (MUWO), Point Reyes National Seashore (PORE), and other parts of Marin County. Through an inventory in 1997 and 1998, approximately 75 pairs of spotted owls were located in Marin County, although large portions of private lands were not surveyed and the overall number of pairs is undoubtedly higher.

In the northern portion of their range, Northern Spotted Owls are typically found in mature coniferous forests (eg. Forsman et al. 1984). In Marin County, they inhabit Douglas fir (*Pseudotsuga menziesii*), coast redwood (*Sequoia sempervirens*), Bishop pine (*Pinus muricata*), mixed conifer-hardwood, and evergreen hardwood forests. Logging occurred in Marin County from the mid 1800's to the mid 1900's and a large fire burned in the mid 1940's, both of which altered forested habitats (Evens 1988). Most of these areas have re-grown and are now mature second growth. All forest types and ages contain a significant hardwood component.

Wet winters and dry summers characterize the Mediterranean climate in Marin County. Rainfall varies according to topography and the ocean influence keeps temperatures moderate year-round. Elevations range from sea level to 784 meters on Mount Tamalpais in southern Marin County.

Previous pellet analyses indicate that Spotted Owls in Marin County forage primarily on dusky-footed woodrats (*Neotoma fuscipes*) which make up over 75% of their diet by weight. Other prey includes small mammals such as deer mice (*Peromyscus maniculatus*), California meadow vole (*Microtus californicus*), and brush rabbit (*Sylvilagus bachmani*) as well as a variety of forest-dwelling birds (Chow and Allen 1997, Fehring 2003).

The Marin County Northern Spotted Owl population is subject to unique threats present in this portion of the range including: 1) urban development along open space boundaries, 2) disturbance due to intense recreational pressures, 3) potential effects of hazardous fuel management practices to Spotted Owl distribution and productivity, 4) potential for catastrophic wildfires along the urban/wildland interface, 5) possible genetic isolation and 6) emergent biological threats (Sudden Oak Death, West Nile Virus, and the continued range expansion of the Barred Owl).

Genetic studies of Northern Spotted Owls indicate that the Marin study area is relatively isolated population of Spotted Owls with minimal gene flow with the rest of the Northern Spotted Owl populations (Barrowclough et al. 2005 and Henke et al. 2003). Barrowclough et al. (2005) indicates that due to the apparent genetic isolation of Marin County's Northern Spotted Owl population, the population warrants special management attention.

Emergent biological threats in Marin County such as Sudden Oak Death (SOD), West Nile Virus (WNV), and the continuing range expansion of the Barred Owl are new threats in which the long-term ramifications are not yet fully understood at this time. Of special concern is the steady influx of Barred Owl detections throughout Marin County. Barred Owls have expanded their range into the Pacific Northwest, and are suspected of displacing Spotted Owls. In reviewing Barred Owl and Spotted Owl locations in Oregon between 1974 and 1998, Kelly et al. (2003) found that when barred owls invade Spotted Owl territories, mean annual occupancy of Spotted Owls decline when compared to territories without Barred Owls. Sudden Oak Death involves the continuing die-off of tanbark oaks (*Lithocarpus densiflorus*), coast live oaks (*Quercus agrifolia*) and several other tree and shrub species throughout Spotted Owl habitat in Marin County. SOD may have long-term impacts on Spotted Owl nesting habitat and prey populations. West Nile Virus (WNV) has been confirmed to be lethal in the Strigidae family and 2004 brought the first positive confirmations of WNV to Marin County. In 2005, WNV was confirmed in fourteen birds located in Marin County.

The parklands in this portion of the Spotted Owl's range are situated within the immediate San Francisco Bay Area and receive several million human visitors each year. Spotted Owl nest sites in Marin County are generally close to roads and trails**.** This is not an indication that Spotted Owls prefer disturbed areas, but likely the result of the high density of trails and fire roads located within potential Spotted Owl habitat and the tendency to locate trails in riparian drainages where owls often nest. As a result of these circumstances, Spotted Owls of this region have a high potential for interaction with humans.

Standard Spotted Owl survey protocols may lead to changes in owl behavior due to repeated calling and the feeding of live mice (*Mus domesticus*) to owls (known as "mousing"). Owls habituated to people may be more vulnerable to disturbance and manipulation by park operations and visitors. Wildlife photographers and well-meaning wildlife enthusiasts have used mice to bring owls closer. Several pairs of spotted owls have been documented frequenting campgrounds, flying down to hikers and roosting near homes. In Marin County, we have developed a modified protocol that reduces the number of mice used to obtain the relevant demographic information. The ease of access to nest sites and high visibility of nesting structures facilitates intensive nest checks as opposed to "mousing" to monitor reproductive status. We rely on increased search time, more frequent visits and we use behavioral observations to gather the data. Some "mousing" is still necessary, but overall we have reduced the use of mice, while still maintaining our ability to obtain accurate reproductive data.

The habitat and nest data collected through the monitoring program has been used to quantify the known and predicted distribution and density of owls through Geographic Information Systems (GIS) analysis, and a habitat model was developed (Fehring et al. in press). We are characterizing habitats around owl nest sites through GIS analysis and in the future hope to relate reproductive success to specific habitat characteristics.

Current Monitoring Objectives:

1. Monitor changes in Northern Spotted Owl abundance and reproductive success at known owl activity sites within the NPS legislated boundaries of Marin County, California.

2. Determine the long-term changes of nest site characteristics (e.g. tree species selected for nest sites, vegetation community selected for nest sites) at Northern Spotted Owl known activity sites in order to evaluate habitat selection.

3. Monitor suitable habitats every 5-10 years in order to identify population expansion of target species and incorporate them into annual abundance estimates.

Study Area

All long-term monitoring surveys occurred within a 53,700-acre area of Marin County, which includes forested lands within the legislated boundaries of PORE, GOGA and MUWO. Some additional surveys also occurred on lands owned by California State Parks (CSP), the City of Mill Valley, and the Marin Municipal Water District (MMWD). Habitat on NPS lands does not necessarily represent conditions across Marin County and in general, the long-term monitoring program results may not apply to areas outside the study area.

Methods

Study Design

The three National Park Service (NPS) units in Marin County (PORE, GOGA, and MUWO) began a joint survey for Northern Spotted Owls in the County in 1993. Previously, there had been informal surveys in the area, but only one pair of Spotted Owls was reported in the 1994 Northwest Forest Plan. The current demography study was started in 1997 and followed the USFWS "Protocol For Surveying Proposed Management Activities That May Impact Northern Spotted Owls" (USFWS 1992). In 1997 and 1998, all evergreen forest habitat located on federal lands within Marin County were thoroughly and systematically surveyed for Spotted Owl presence using the Pacific Northwest Research Station's protocol (Forsman 1995). Of the approximately 75 Spotted Owl activity sites documented during the 1997-1998 inventory, 46 sites were selected for annual long-term monitoring. The 46 sites were chosen to represent a variety of habitat types and according to the amount of existing data, ongoing management concerns, accessibility, and funding availability. In 2004, we reduced the number of sites we monitor for reproductive status information to 30 sites, which are selected randomly each year from the 46 long-term monitoring site list. The remaining 16 sites are monitored for occupancy only.

For all reproductive and occupancy sites, we have continued to use the Marin Modified Protocol developed for use in areas with high potential owl/human interaction. We modeled the "Modified Protocol For Spotted Owl Monitoring and Demographic Studies in Marin County California" directly after the "Spotted Owl Monitoring Protocols for Demographic Studies" (Forsman 1995). The main goals of the Marin Modified Protocol are to reduce "mousing" while capitalizing on the accessibility of nest sites and the high incidence of visible platform nests in Marin County.

Between 1998 and 2003, we captured and color banded owls at 26 sites within a 24,700 acre study area centered around Bear Valley in Point Reyes National Seashore. In 2004, we ceased banding Spotted Owls due to logistical constraints and limited sample size. We have continued to determine band identification on all spotted owls encountered. Additional sites surveyed for management purposes also serve to expand the probability of resighting banded owls that have relocated out of the central study area as well as detecting Barred Owls in the area.

For the purpose of this report, only data from the 46 long-term monitoring sites are included, with the exception of the analysis of nesting habitat and nest structures that includes data gathered on all unique nests located in the county since 1997 (reused nests were included only once). All owl activity centers (either nest location or major roost site) are recorded in GPS (Global Positioning System) coordinates using a Garmin 3+ or similar GPS unit. Roost sites or nest trees for which GPS satellite access is not available are mapped on topographic maps from compass bearings taken in the field and GPS coordinates are obtained by using ArcView 3.3 (ESRI 2002). Each year at every known nest location, nest tree parameters are measured and surrounding habitat is described.

Occupancy and reproductive status classifications are based on specific decision criteria using Marin County Spotted Owl Monitoring Protocol. Fecundity was calculated by dividing the number of female fledglings (assuming a 1:1 sex ratio) by the number of territorial females (Franklin et al. 1996). Fecundity estimates include only females with known reproductive outcomes, resulting in a higher fecundity estimate than if we included females with unknown reproductive status.

All site search, owl detections, and nest record field data are compiled in a Microsoft Access database maintained at Point Reyes National Seashore. All areas surveyed are mapped using ArcView 3.3 GIS software program and the data layers are made available to agencies involved in land management and planning projects within Marin County. We plan to submit the 2002 through 2005 Spotted Owl location data to the CA Natural Diversity Database Project (Rarefind) and the Biogeographic Information and Observation System (BIOS) database**.** In addition, we provide the U.S. Department of Fish and Game and the Marin County Development Agency with Spotted Owl locations.

Results and Discussion

General Monitoring and Site Status

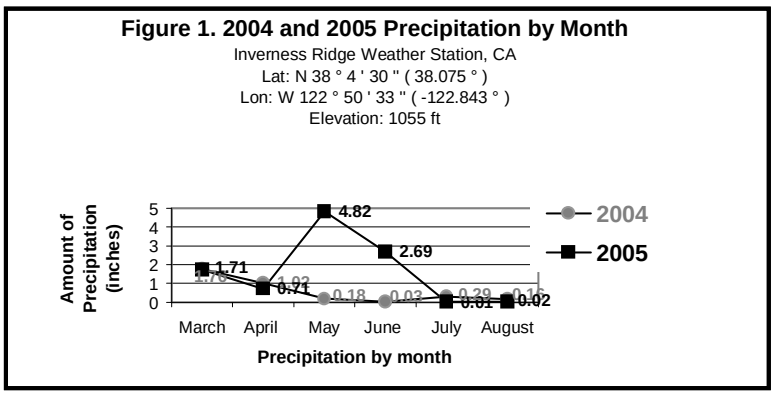
On March 4, 2005, Spotted Owl staff members assembled at Point Reyes National Seashore to discuss the results of the Marin County Spotted Owl Monitoring Protocol review. The meeting was focussed on streamlining and reshaping monitoring objectives into measurable objectives with time frames. A second meeting occurred on March 24th when the entire Spotted Owl field crew met to review protocol and data collection procedures in preparation for the 2005 field season. The 2005 field crew was composed of returning staff members from the 2004 breeding season and a handful of long-term volunteers. Three of the field crew members (two PRBO interns and one NPS biological technician) were full-time on the project in 2005.

From March 1st to August 25th, the survey teams made 289 visits (mean visits/site=6.3, range 1-17) to a total of 46 Spotted Owl territories designated as long-term monitoring sites. Survey efforts were not evenly distributed throughout the 46 sites and were concentrated on the subset of 30 sites randomly selected to fulfill reproductive success requirements for the 2005 breeding season. Seventy-eight percent or 225 visits were made to the 30 reproductive monitoring sites. The remaining 22% of the visits were made to the 16 occupancy sites.

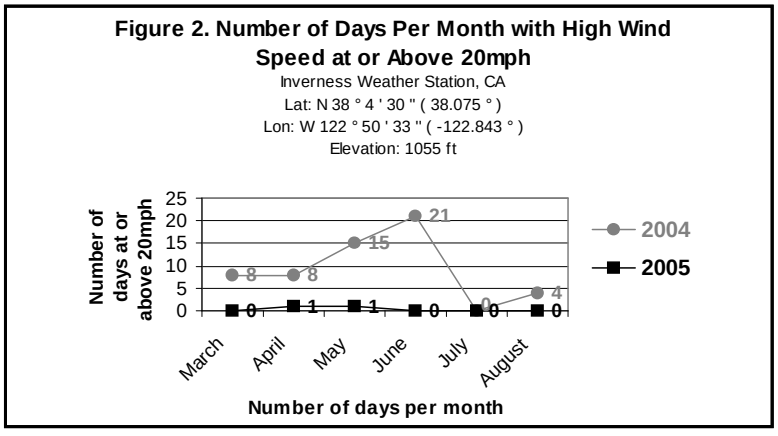
Weather

Tabular weather data for precipitation and wind speed collected in 2004 and 2005 at the Inverness Ridge, CA weather station (www.weatherunderground.com) from March 1st to August 31st, was used to compare weather patterns during the two breeding seasons. In general, the weather between the 2004 and 2005 breeding seasons was strikingly different with the 2005 overall weather pattern being wet and calm, compared to a drier, more windy 2004 breeding season (Figure 1 and 2). Fecundity was very similar for both years (Figure 5).

Precipitation data collected from March 1st to August 31st 2005 at the Inverness weather station indicated a total of 9.96 inches (253mm), nearly 3 times the 2004 total of 3.44 inches (87mm) collected between these dates last year (Figure 1). Since high winds were suspected to play a part in the deterioration of multiple nest structures in 2004, the 2004 and 2005 high wind speeds (sustained winds) and high wind gusts (intermittent burst of wind speed) were compared during the March 1st to August 31st window (Figure 2).



In 2005, high wind speed only reached at or above 20 mph twice from March 1st to August 31st. On April 22nd, 2005 the high wind speed reached 24 mph and on May 18th, 2005 the high wind speed was recorded at 20 mph. Where as in 2004, high wind speed was documented at or above 20 mph a total of 56 times during the same time period.

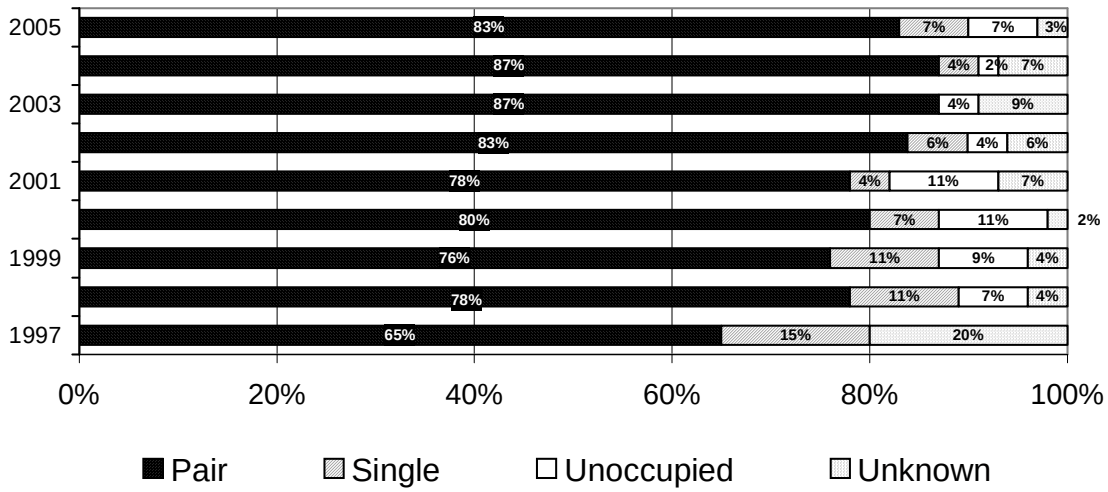


The highest wind gust for the 2005 breeding season was documented at 47 mph on May 18th. In 2004, wind gusts were documented at or above 47 mph thirteen times during the breeding season with the highest wind gust of the season recorded at 55 mph on May 10th.

Occupancy Status

Based on established survey criteria, pairs of Spotted Owls occupied 83% or 38 of the 46 long-term monitoring sites. The percent of sites occupied by pairs or single owls has remained fairly constant over the past eight years at about 90% (Figure 3). This is not unexpected due to the lack of major habitat changes observed over the study period. The percent of sites unoccupied also remained fairly constant and frequently the same sites were unoccupied every year. Results for 1997 were difficult to interpret due to the high percentage of sites with unknown occupancy status.

Figure 3. Occupancy status shown as a percentage of total study sites for 1997-2005 (n=46 annually).

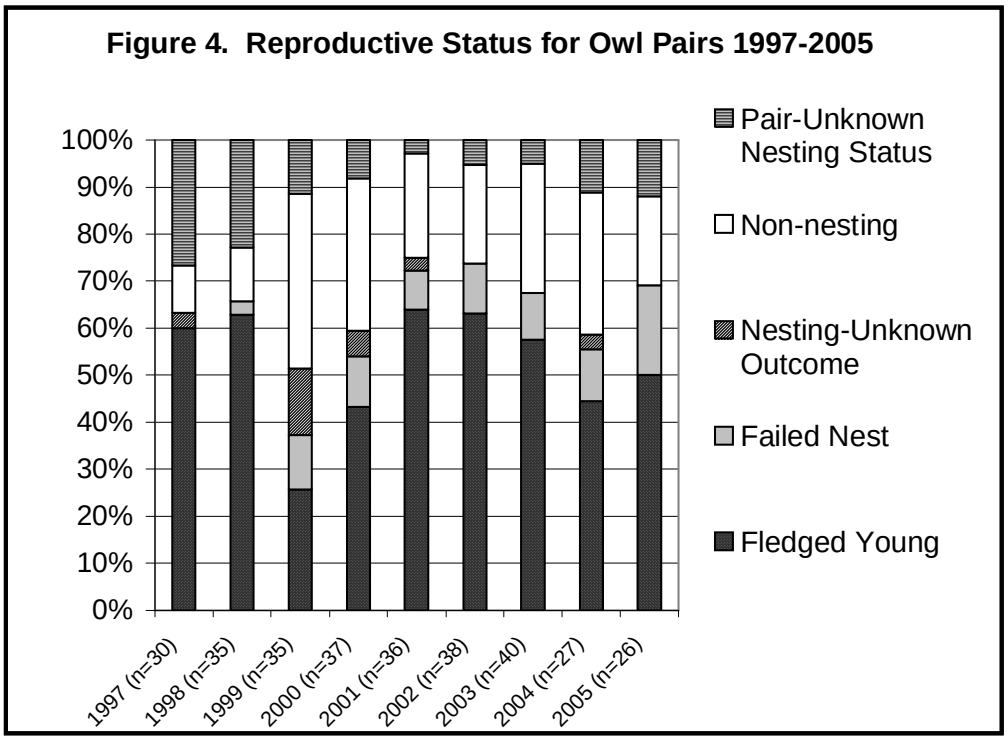


Reproductive Status and Fecundity

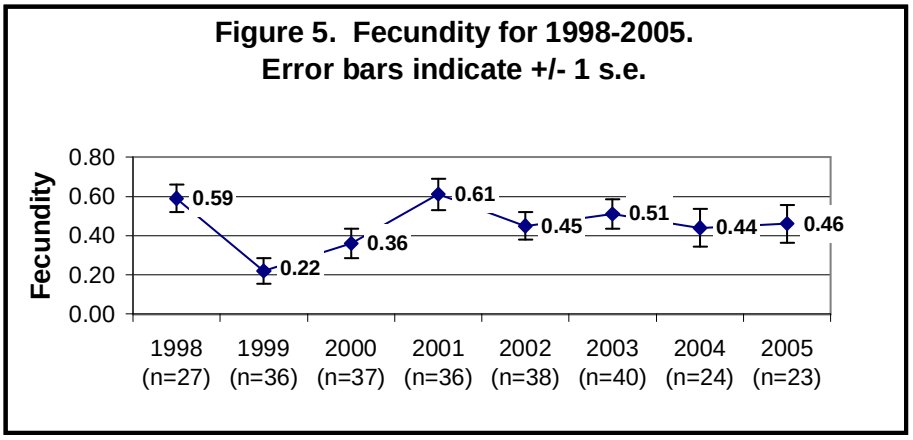
At the 30 sites monitored to reproductive status in 2005, a total of 25 sites had Spotted Owl pairs. Of the 26 females with known reproductive status, which includes one non-nesting (resident single) female, 18 females (69%) attempted nesting. Thirteen of the 18 females successfully nested yielding a confirmed total of 21 young. Twenty percent of nesting attempts in 2005 resulted in nest failure in accordance with Marin Modified Protocol requirements. A total of four non-nesting females were confirmed at the 30 sites monitored to reproductive status.

Of the sixteen sites that were monitored for occupancy purposes, a total of six females were documented with successful nests and fledged an unconfirmed total of eight offspring. Non-nesting females were confirmed at two of 16 occupancy sites. At

occupancy sites, the initial fledgling count was often not confirmed with a second count to meet protocol requirements for definitive reproductive success.

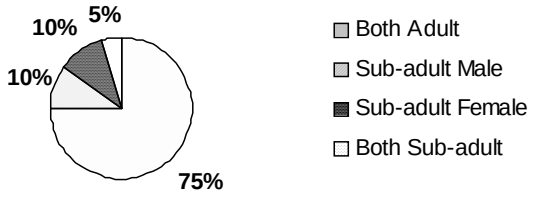


Fecundity (± SE) is defined as the number of female young fledged per territorial female. The 2005 breeding season was an average reproductive year locally. Fecundity for 2005 in Marin County was 0.46 (s.e. ±0.096) which reflects the average fecundity of 0.46 (s.e. ±0.078) for the years 1998-2005 (Figure 5).



Adult owls are contributing most of the reproductive effort in this population as compared to sub-adults (one and two year old owls, also called second year and third year owls). Of the 315 total pairings with both owl ages documented between 1997 and 2005, 64 pairs (20%) consisted of one adult and one sub-adult (Figure 6). Of the fifteen pairs where both were sub-adults (5%) only one pair has attempted to nest and they successfully fledged two young.

Figure 6. Age of Owls in all pairings 1997-2005 (n=315).



Nesting Habitat and Nest Structures

We have located 195 Spotted Owl nests in Marin County since 1997. In 2005, researchers located 26 nest trees, which included twenty-two unique nest trees and four nest trees that have been reused. Of the four reused nest trees, a Douglas fir platform was reused for a fourth year, two Redwood platforms were reused for a third year, and a Douglas fir cavity was being reused for a second year. A total of twenty-seven nests have been reused during the last nine years. Of the 195 unique nests, 19 (9%) are cavities and 176 (91%) are platform nests. Platform structures in Marin have included tree forks, large limbs, broken top trees with lateral branches, old raptor, corvid, squirrel, and woodrat nests, debris piles, poison oak tangles (*Toxicodendron diversilobum*) and dwarf mistletoe infestations (*Arceuthobium spp*.). Cavity nests included both side entry and top entry cavities.

The ratio of nest types in Marin is similar to the ratio seen in other younger aged forests such as the Wenatchee National Forest on the east slope of the Cascade Mountains in Washington (Buchanan and Irwin 1993). In the Wenatchee study, 16.5% of nests were cavities; while in older forests in Northwestern California and the Olympic Peninsula in Washington, 80% and 90% of nests were in cavities, respectively (LaHaye and Gutierrez 1999; Forsman and Griese 1997). LaHaye and Gutierrez (1999) theorized that nest type depends on the age of the forest and this is supported in Marin where both logging and fire have created a younger-aged forest habitat.

Nests have been documented in a variety of tree species including coast redwood (43%), Douglas fir (36%), bishop pine (8%), California bay (*Umbellularia californica*) (7%), tanbark oak (3%) and coast live oak (3%). The average diameter at breast height (dbh), nest height and tree height for all nests located over the past nine years are presented in Table 1. Eighty-four percent of cavity nest tree dbh measurements were greater than 100cm while only 37% of platform nest tree measurements were over 100cm. This was expected given the size and maturity needed for cavities and other deformities to develop. Seven platform nest trees had a dbh of less than 30cm.

Table 1. Nest measurements for 195 unique nests located in Marin County, California from 1997 to 2005.

	Platform Nests (n=176)		Cavity Nests (n=19)	
	Mean	SE	Mean	SE
dbh (cm)	91.3	±3.62	131.6	±10.53
Nest height (m)	19.5	±0.53	21.7	±2.36
Tree height (m)	32.5	±0.98	37.3	±3.90

Banding

Of the 110 Northern Spotted Owls banded before 2004, 50 were banded as juveniles, 23 as subadults, and 37 as adults. In 2005, 31 banded owls were resighted (14 females and 17 males), with three owls resighted in different locations. Of the three banded owls (two females and one male) resighted at new locations in 2005, only the male's identity could be positively determined due to a combination of color band duplicates and missing colored tabs. A total of 11 spotted owls (8 juveniles and 3 adults) whose identity has been positively determined have been resighted at new territories since 1999. The two band resights from 2005, whose exact identity cannot be determined without recapture, are both females that were banded as juveniles in 2001 and 2002. The known owls that dispersed to a new territory include 8 of the 50 owls banded as juveniles as well as 3 males banded after their juvenile year. The eight resighted juveniles moved an average distance of 7.4 km (n=8) from where they were banded. The shortest distance moved by a juvenile was 2.0 km and the longest was 13.5 km. Three of these owls were detected outside the demography study area at other sites. Two sub-adult males moved distances of 5.7 and 6.4 km while one adult male relocated to the adjacent territory 1.0 km away. The average distance the three non-juveniles moved was 4.4 km.

Four adult owls were observed missing the colored tabs from their color bands (the bands were still in place) in 2005. One of the four owls includes a male missing both color band and colored tab, but the USFWS band was still in place. The identity of only two of these four owls can be positively determined due to missing tabs and bands.

Research Activities and Recommendations

Diseases and Parasites

Two nesting females in the Marin County study area were affected by what appeared to be ectoparasites in 2005. Both of the female's degraded feather conditions were first observed and documented on May 25th by two different survey crews. On May 25th, the female exhibiting the worst feather condition was photographed and her breast and belly contour feathers from throat down to just above tarsus appeared to have been eaten down to the rachis leaving only the downy feathers visible. In addition, the edges of the dorsal coverts and remiges from wrist down as well as rectrice tips are frayed and disintegrated on edges. Photos of this female were distributed to spotted owl researchers in the Olympic Peninsula, Roseburg BLM, USDA Forest Service, Oregon State University, and Colorado State University. Based on personal commentary via e-mail from Dr. Alan Franklin and Dr. Eric Forsman, neither of them had seen feather condition this poor before. Eric Forsman speculated it was a severe case of feather mites that was acquired during incubation, although this could not be proved without collecting the ectoparasites from the female. After nest failure was confirmed, nesting material and eggshell fragments were collected from the nest cavity on June7th, 2005. The female's feather condition was opportunistically monitored and on July 27th the female's feather condition had significantly improved and her breast feathers were 80- 90% molted. The second female whose degraded feather condition was not as severe, successfully nested and fledged two young.

Barred Owls and Hybrids

Barred Owls are an eastern species of owl that has moved across the Canadian Rocky Mountains and down the west coast of the United States. Barred Owls are slightly larger than Spotted Owls and appear to exhibit aggressive behavior toward Spotted Owls. The first Barred Owl record for Marin County occurred in May 2002 in MUWO. Physical confrontations and aggressive interactions between Barred and Spotted Owls have been documented at multiple Spotted Owl sites within Marin County. Temporary and permanent displacement of Spotted Owl pairs from their historic sites as a result of the immigration of the Barred Owls into the Spotted Owl's range has been documented by biologists in the Pacific Northwest. Marin County is likely to see a similar effect and the ramifications of Barred Owl occupancy in relation to reproductive success of the Northern Spotted Owls are not yet known.

In 2005, a total of 13 separate Barred Owl (4 unknown sex, 8 male, and 2 female) detections were recorded in Marin County at seven historic spotted owl territories. Eleven of the 13 incidental detections (85%) were concentrated at 5 of 61 actively monitored Spotted Owl territories in 2005. The additional two detections occurred at historic Spotted Owl territories not actively surveyed in 2005. Five of the seven sites, where

Barred Owls were detected in 2005, are concentrated in a three mile (4.9 km) area on the west side of Bolinas Ridge and Olema Valley. Since Barred Owls in Marin County are not marked, the exact number of individuals cannot be confirmed. Based upon the sex determination, frequency of the incidental barred owl detections, and distance between Barred Owl detections, it is likely that at least three individuals (two males and one female) are current residents of Marin County. This is the fourth year a male Barred Owl has been detected at MUWO and the second year a male Barred Owl was located on the west side of the Bolinas Ridge. The distance between the two Spotted Owl sites affected by male Barred Owls is greater than 14km and incidental male Barred Owl detections occurred less than 24 hours apart on May 11th and 12th at the two sites which suggests the presence of two males. A single female Barred Owl was detected in early April, 5.8 miles (9.4 km) east of the town of Olema. In August, biologists recorded the first Barred Owl pair detection in Marin County, less than a mile (1.4 km) west of the 2005 male Barred Owl's location on the Bolinas Ridge.

At both Spotted Owl sites (Bolinas Ridge and MUWO) with the presence of male Barred Owls, the male Barred Owls appeared to interact aggressively with the Spotted Owl pairs. On May 12th, May 23rd, and June 1st, a male Barred Owl was located on day surveys in close proximity to an active Spotted Owl nest and/or juvenile Spotted Owl on the Bolinas Ridge. In two incidences, the male Barred Owl was within 5 meters of the adult male and female Spotted Owls. On both occasions, the male Barred Owl vocally interacted with the adult Spotted Owls and on one of the visits chased the female Spotted Owl away from the nest core area. Although the interactions appeared to be aggressive, the Barred Owl was never observed approaching the two Spotted Owl juveniles and the young successfully fledged. In contrast, nest failure was confirmed at the Spotted Owl nest at MUWO for the second year in a row.

As of 2005, no nesting by Barred Owls has been documented. To date, no Spotted/Barred Owl hybrids have been detected at any of the long term monitoring sites. Future staff members and volunteers should be made aware of the potential of hybridization and the importance of confirming the identity of both pair members.

In response to the steady influx of Barred Owls into the most southern part of the Northern Spotted Owl's range, a study is being developed to investigate habitat use and movement patterns of Barred Owls. The project would be a joint project from GOGA, MUWO, and PORE with the hope of collaborating with other Barred Owl biology studies across the range of the Northern Spotted Owl. Preliminary objectives of the study are to track Barred Owl movements, predict areas likely to see Barred and Spotted Owl interactions, provide insight to the overlap of diet, habitat use, and interspecific behavior. Barred Owls would be banded with color and USFWS bands and attached with radio transmitters. Ultimately, the study would provide a better understanding of the magnitude of the threat Barred Owls present to the long-term persistence of Marin County's Northern Spotted Owl population. Furthermore, we may learn more about management

needs to benefit Spotted Owls in the presence of Barred Owls. We hope to implement the study in 2007, funding dependent.

Prey Analysis

We participated in a prey analysis study by Dr. Eric Forsman of the US Forest Service Pacific Northwest Research Station. The objective of the study was to investigate the potential presence of California red tree voles (*Arborimus pomo*) in Marin County. Both Northern Spotted Owls and California red tree voles are known to inhabitat overlapping coniferous habitats from Sonoma County north to Oregon. Prey results provided by Forsman indicate that Marin County is outside the range of the red tree vole. During the 2005 breeding season, pellets were collected from 10 Spotted Owl sites representing a wide range of forest habitats including Douglas fir, redwood, and Bishop pine forest types within Marin County. The pellets collected in 2005 contained a total of 69 prey items. The combined percentages by biomass of dusky-footed woodrats and Norway rats amounted to 79% (Figure 8). This reinforces previous prey studies that indicate large prey items constitute 79-94% of the Spotted Owl diet by biomass in Marin County (Chow and Allen 1997, Fehring 2003). The frequency of prey (by number) indicates that the most frequent prey items taken in 2005 were the dusky-footed woodrats (49%) and deer mice (32%) (Figure 9). The high frequency and percent biomass of the dusky-footed woodrat also reinforce prey studies indicating the Spotted Owl and woodrat predator/prey relationship in this region (Chow and Allen 1997, Fehring 2003). At Spotted Owl sites where Norway rats were consumed, contact with landowners will be made to reinforce the detrimental effects that the use of rat poison can have on Spotted Owls as well as other predatory and scavenging species.

Figure 8. Percent of Prey Biomass in Owl Pellets (2005)

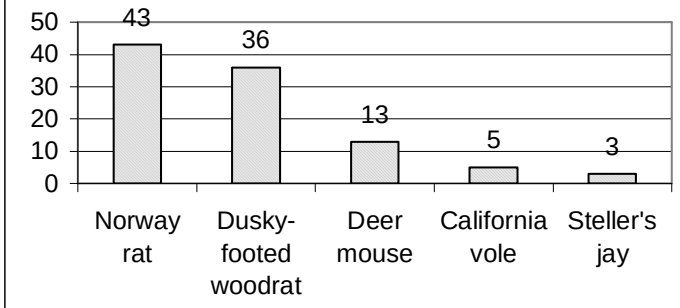
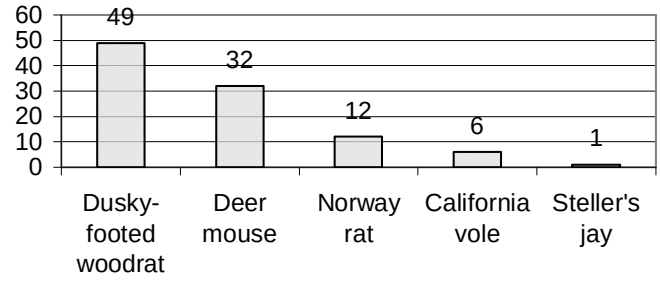


Figure 9. Percent of Prey (by number) in Owl Pellets (2005)



Sudden Oak Death

Marin County is one of fourteen counties in California affected by the pathogen *Phytophthora Ramorum* that causes Sudden Oak Death (SOD). *P. ramorum* is a water mold that acts like a fungus, attacking the trunk of a tree and causing a canker, or wound that eventually cuts off the tree's flow of nutrients. Other secondary decay organisms such as beetles and fungi often move in after the tree is infected. Trees infected with SOD may survive for one to several years as the infection progresses. As the tree finally dies, the leaves may turn from green to brown within a few weeks, hence the appearance of sudden death. Tanoaks (*Lithocarpus densiflorus)* and coast live oaks (*Quercus agrifolia*) are killed by the disease; other species affected are known as "foliar hosts" because their leaves and twigs may be infected. These foliar hosts can spread the disease, but are only occasionally killed.

The diversity of host species affected by *P. ramorum* indicate potential long-term landscape modifications through changes in the forest canopy, understory, and ground layer (Rizzo and Garbelotto 2003). A large scale habitat change due to *P. ramorum* has the potential to affect the whole forest ecosystem. Specifically, SOD has the potential to affect Spotted Owls through loss of canopy cover in roosting and nesting areas and changes in prey species due to loss or changes in prey habitat. Spotted Owl habitats affected by oak and tanoak dieoffs as a result of SOD are located in Samuel P. Taylor State Park, Mt. Tamalpais State Park, MUWO, Mill Valley, GOGA and most recently SOD was confirmed at multiple locations within PORE. For comprehensive information regarding SOD and links to current maps visit the California Oak Mortality Task Force website at www.suddenoakdeath.org.

Management of the pathogen at the Spotted Owl project level includes incorporating measures to prevent the spread of *P. ramorum*. As the range of SOD expands, simple precautionary measures and decontamination procedures will be added to our monitoring efforts in 2006 so that we do not facilitate the transfer of infected plant material or soil to unaffected areas. Field crews that suspect an area is being affected by SOD should at the very least, briefly describe the location and obtain GPS coordinates.

West Nile Virus

West Nile Virus (WNV) is an arbovirus that first appeared in the Western Hemisphere, specifically New York, in the early fall of 1999. Mosquitoes and migratory birds are the main species involved in the spread of WNV. Mosquitoes are the principle vector and avian species are considered the principle host species for WNV. WNV first appeared in California in 2002. By 2004, WNV had spread to all 58 counties of California and a total of 3,323 birds tested positive for WNV. A total of 18 birds tested positive for WNV in Marin County in 2004. Collectively in 2005, the top four species of birds infected by WNV in California were the American Crow (*Corvus brachyrhynchos*), Western Scrub-

Jav (*Aphelocoma californica*), Yellow-billed Magpies (*Pica nuttalli*), and Steller's Jay (*Cyanocitta stelleri*). In 2005, 52 of California's 58 counties have recorded a total of 3,046 dead birds infected with WNV. Fourteen birds in Marin County, located in the cities along the Highway 101 corridor, tested positive for WNV in 2005. For historical and current information that is updated weekly visit http://westnile.ca.gov/

Raptors and owls have been noted to be particularly susceptible to WNV. A Spotted Owl was confirmed to have died from WNV at a captive wildlife facility, indicating that Spotted owls are susceptible to WNV. Special attention should be paid during the 2006 field season to document fatalities that may be due to West Nile Virus. Carcasses should be tested whenever possible and the population should continue to be monitored for declines due to this new threat.

Management Activities and Recommendations

Northern Spotted Owls in Marin County face a unique set of threats. In contrast to the Pacific Northwest, large-scale loss and modification of habitat due to commercial logging is not the primary threat. Humans and their activities, including development along the wildland/urban interface, land management practices, and recreation are the most significant sources of impact. We recommend that owl surveys continue, and that land managers use these data to ensure that management activities do not impact the habitat or the productivity of Northern Spotted Owls. We encourage continued communication between land managers and their maintenance crews in planning and executing projects in Spotted Owl habitat. Information on owl site locations should continue to be made available to all land managers and local city and county planning departments and can be accessed through the California Department of Fish and Game (CADFG) Natural Diversity Database (www.dfg.ca.gov/whdab/html/cnddb.html). Marin County Spotted Owl locations accompanied by metadata can also be accessed through the Biogeographic Information and Observation System (BIOS) database that is managed by Gordon Gould of the CADFG. In addition, the U.S. Department of Fish and Game and the Marin County Development Agency receive Spotted Owl location information.

Given the mixed ownership patterns in Marin County, several owl home ranges contain both public and private lands. Coordination between park managers and local planners is essential and a process for ongoing transfer of owl location information should be developed. Loss of owl habitat and owl pairs due to urban development is an urgent local threat. Due to the isolated nature of the Marin County owl population, declines along the urban edges may impact overall population health throughout the local range.

Public Outreach

Due to the consistent public interaction with Marin County's Northern Spotted Owl population, a proactive approach needs to be taken to inform the public of their role of living and working in areas with Spotted Owls. In 2000, the National Park Service developed a draft informational brochure that focussed on living and working in Spotted Owls habitat within Marin County. The 2000 draft version of the brochure is posted on the internet at http://www.nps.gov/muwo/nature/birds/owl/ecology/. In 2005, a technical grant was obtained and the draft brochure was resurrected. The goal of the brochure is to introduce Marin County residents, land owners, and agency managers to basic Spotted Owl biology, guidelines for protecting Spotted Owls and their habitat in this county, and how to minimize potential threats to Spotted Owls. The cities of Fairfax and Mill Valley have already expressed interest in having Spotted Owl information available to distribute to landowners. Additional outreach will include a letter that will be distributed to local birding groups and leaders in early spring of 2006 outlining birding etiquette in areas where Barred and Spotted Owls are known to interact. The letter will also request that any incidental sightings of Barred or Spotted Owls be reported to the NPS Spotted Owl biological technician at PORE.

Owl Rehabilitation

On June 27, 2005, WildCare (Terwilliger Nature Education and Wildlife Rehabilitation) notified the NPS and PRBO that a juvenile Spotted Owl was brought into the rehabilitation facility by homeowners in the Larkspur area after the juvenile was found on the homeowner's deck. Upon initial check of owl, Wildcare determined the juvenile's weight was adequate, but a preliminary blood test indicated a blood parasite. More detailed blood tests were run later that day to determine treatment and release date which was tentatively scheduled for the afternoon on June 28th. On June 28th, 2005 the blood work came back negative, but it was not until at this time that PRBO was informed that a wing injury was detected. The juvenile's patagium was determined to be severely damaged and WildCare decided that it was unlikely that it would ever by able to fly. As of September 2005, a rehabilitator was working with the juvenile and it was reported that the juvenile may learn to fly again, but it will never recover to the point where it could be released.

Barred Owl Conference

On June 14th and 15th, 2005 Spotted Owl researchers from Washington, Oregon, and California assembled at Humboldt State University in Arcata, California to discuss Barred Owl biology, Spotted and Barred Owl interspecific interactions, and Barred Owl research needs. Bill Merkle (GOGA, Wildlife Ecologist and project lead) and Heather Jensen (PORE, field crew leader) represented the Marin County at the Barred Owl Conference. The conference was organized and facilitated by Sustainable Ecosystems

Institute. Funding for the conference was provided by US Fish and Wildlife, Washington Department of Fish and Wildlife, US Forest Service, and Bureau of Land Management. As a result of the conference, a Barred Owl resolution was drafted which encouraged research to provide scientifically sound evidence of the impacts of Barred Owls on Spotted Owls to aid future management decisions. A copy of this resolution and a list of scientists who support the resolution can be viewed at http://www.sei.org/owl/BarredOwlWorkshop.htm.

Conservation Genetics

We are continuing to opportunistically collect Northern Spotted Owl feathers with the potential to provide these to researchers for genetic analysis. Feather samples collected in 1999 and 2000 from Marin County's population were submitted to the Conservation Genetics Laboratory at San Jose State University. The Conservation Genetics Lab compared Marin County's Northern Spotted Owl population with other populations of Northern and California Spotted Owls. Genetic research indicated that the Marin County Spotted Owl population has very little gene flow with Spotted Owl populations farther to the north (Barrowclough et al. 2005 and Henke et al. 2003). Barrowclough et al. (2005) indicates that due to the apparent genetic isolation of Marin County's Northern Spotted Owl population, the population warrants special management attention.

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